Serial No.: 09/848,997
Group Art Unit: 2822

REMARKS

Claim Rejections - 35 USC §102

Claims 1-6 are rejected under 35 USC §102(e) as being anticipated by Levert et al. (USPN 6,407,006, hereinafter "Levert").

Pertaining to claims 1-6, Applicant has cancelled claim 1 and amended claim 2, which now includes the limitation not disclosed in Levert of:

> "...applying the mechanical pressure includes providing rotary and traverse motion between the mechanical device and the ILD layer..." [deletions and underlining for clarity]

The support for the amendment is in the Specification page 5, lines 8-15:

> "In one embodiment, the semiconductor wafer is subject to thermal energy applied by means of the top plate 16, which is heated, and moved relative to the semiconductor wafer 14. The plate both rotates, as indicated in FIG. 1 by the arrow 20, and traverses, as indicated in FIG. 2 by the arrow 30.
>
> In another embodiment, the semiconductor wafer 54 is subject to the mechanical pressure of the roller 56, which is heated to provide thermal energy. The roller 56 rotates in the direction indicated by the arrow 60 in FIG. 3 and also traverses as indicated by the arrow 70 in FIG. 4." [underlining for clarity]

The Examiner in the Office Action item 3 states:

> "Levert et al. teaches placing a semiconductor wafer having an interlevel dielectric layer (ILD) on a wafer holder of an oven, applying mechanical pressure to the ILD layer using a mechanical device, applying heat simultaneously with the mechanical pressure (col. 7, lines 60-68, col. 26, lines 24-26). Levert et al. shows applying the mechanical pressure includes relative motion to assist in planarization, providing a non-sticking motion, sensing and controlling the temperature of the mechanical device (Abstract, col, 8, lines 5-15). Levert et al. shows the mechanical device using a roller (col 7, lines 20-27)."

Assuming *arguendo* that the above is correct, it is respectfully submitted that Levert does not disclose, teach, or suggest rotary and traverse motion, which would have the effect of spreading the ILD rather than merely compressing it as in Levert. The rotary and traverse motion would be especially advantageous with nanopore materials because the nanopores would not be subject to compression, which would tend to increase the dielectric constant of the materials.

Claims 3-6 have been amended to depend from amended claim 2 and are believed to be allowable because they contain all the limitations set forth in the independent claim 2 from which they depend.

Based on the above, it is respectfully submitted that claims 2-6 are no longer anticipated under 35 USC §102(b) based on Long.

Claim Rejections - 35 USC §103

Claims 7-14 are rejected under 35 USC §103(a) as being unpatentable over Levert et al. (USPN 6,407,006, hereinafter "Levert") in view of Oaks et al. (USPN 6,083,661, hereinafter "Oaks").

Pertaining to claims 7-14, Applicant has cancelled claim 7 and amended claim 8, which now includes the limitation not disclosed in Levert and/or Oaks of:

> "...the applying the mechanical pressure includes providing rotary and traverse motion between the mechanical device and the ILD layer..." [deletions and underlining for clarity]

The support for this amendment is in Specification page 5, lines 8-15, supra.

The Examiner states in the Office Action item #4:

> "Levert et al. shows the mechanical device using a roller (col. 7, lines 20-27)."

It is respectfully submitted that Levert does not disclose, teach, or suggest rotary and traverse motion, which would have the effect of spreading the ILD rather than merely compressing it with only rotary action as in Levert. It is also respectfully submitted that Oaks also does not teach or suggest this limitation.

Oaks also does not disclose, teach, or suggest rotary and traverse motion but discloses in Oaks col. 17, lines 10-13, a non-pressure, heat curing process using infrared energy:

> "One may also cure the resin film in an infrared belt furnace. A suitable furnace and procedure are disclosed in P. E. Garrou et al., Rapid Thermal Cure of BCB Dielectrics, Proceedings ECTC, San Diego, May 1992, pp. 770-776. A Radiant Technology Corporation Model No. LA-306 infrared belt oven may be used with a nitrogen atmosphere..." [underlining and deletions for clarity]

Serial No.: 09/848,997
Group Art Unit: 2822

It is respectfully submitted that the above does not teach or suggest the claimed combination of rotary and traverse mechanical pressure. Thus, neither Levert nor Oaks discloses, teaches, or suggests the combination including the claimed limitation.

Based on the above, it is respectfully submitted that claims 8-14 are unobvious under 35 USC §103(a) based on Levert in view of Oaks.

Other

The paragraph which begins on page 5, line 12, of the Specification has been amended to correct a typographical error.

Claims 11 and 12 have also been amended to describe the motion of the mechanical pressure as rotary and "traverse", instead of transverse", to correspond with the Specification on page 5, lines 8-15, supra.

Conclusion

In view of the above, it is submitted that the claims are in condition for allowance and reconsideration of the rejections is respectfully requested. Allowance of claims 2-6 and 8-14 at an early date is solicited.

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including any extension of time fees, to Deposit Account No. 50-0374 and please credit any excess fees to such deposit account.

Respectfully submitted,

Mikio Ishimaru

Mikio Ishimaru
Registration No. 27,449

Telephone: (408) 738-0592
Fax: (408) 738-0881
Date: February 18, 2003

Serial No.: 09/848,997
Group Art Unit: 2822

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

- Please amend the paragraph which begins on page 5, line 12, of the Specification by inserting the underlined text and deleting strike-through text as follows:

In another embodiment, the semiconductor wafer 54 is subject to the mechanical pressure of the roller 56, which is heated to provide ~~therami~~ thermal energy. The roller 56 rotates in the direction indicated by the arrow 60 in FIG. 3 and also traverses as indicated by the arrow 70 in FIG. 4.

IN THE CLAIMS:

- Claims 1 and 7 have been cancelled.
- Please amend claims 2-6 and 8-14 by inserting the underlined text and deleting strike-through text as follows:

2. (Amended) ~~The~~ A method ~~as claimed in claim 1 wherein~~ for planarization of ILD layers on a semiconductor wafer comprising:

providing an oven having a wafer holder provided therein ;

placing the semiconductor wafer on the wafer holder;

applying mechanical pressure to the ILD layer on the semiconductor wafer using a mechanical device, the applying the mechanical pressure includes providing ~~relative~~ rotary and traverse motion between the mechanical device and the ILD layer on the semiconductor wafer to assist in planarization; and

applying heat to the ILD layer on the semiconductor wafer using the mechanical device simultaneously with the applying the mechanical pressure.

3. (Amended) The method as claimed in claim ~~1~~ 2 wherein:

applying the mechanical pressure includes providing non-sticking motion and transferring heat between the mechanical device and the ILD layer on the semiconductor wafer to assist in planarization.

4. (Amended) The method as claimed in claim ~~1~~ 2 wherein:
applying the heat includes sensing and controlling the temperature of the mechanical device.

5. (Amended) The method as claimed in claim ~~1~~ 2 wherein:
applying the mechanical pressure uses a top plate as part of the mechanical device.

6. (Amended) The method as claimed in claim ~~1~~ 2 wherein:
applying the mechanical pressure uses a roller as part of the mechanical device.

8. (Amended) ~~The~~ A method for planarization of ILD layers on a semiconductor wafer comprising: ~~as claimed in claim 7 wherein:~~
providing an oven having a rotatable wafer holder provided therein;
placing the semiconductor wafer on the wafer holder;
rotating the wafer holder with the semiconductor wafer thereon;
spining on the low dielectric constant ILD material on to the semiconductor wafer in the oven;
soft baking the low dielectric contstant ILD material at a soft bake temperature in the oven;
holding the low dielectric constant ILD material at a temperature below the hard back temperature in the oven;
applying mechanical pressure to the ILD layer on the semiconductor wafer using a mechanical device to apply rotating pressure to the ILD layer in the oven, the applying the mechanical pressure includes providing ~~traverse~~ rotary and traverse motion between the mechanical device and the ILD layer on the semiconductor wafer to assist in planarization;
applying heat to the ILD layer on the semiconductor wafer through the mechanical device simultaneously with the applying the mechanical pressure in the oven;
hard baking the low dielectric constant ILD material at a hard bake temperature in the oven;
cooling the low dielectric constant ILD material in the oven; and
annealing the low dielectric constant ILD material in the oven.

9. (Amended) The method as claimed in claim ~~7~~ 8 wherein:
applying the mechanical pressure includes providing non-sticking sliding motion and transferring heat between the mechanical device and the ILD layer on the semiconductor wafer to assist in planarization.

10. (Amended) The method as claimed in claim ~~7~~ 8 wherein:
applying the heat includes infrared sensing and controlling the temperature of the mechanical device through a phase lock loop temperature control.

11. (Amended) The method as claimed in claim ~~7~~ 8 wherein:
applying the mechanical pressure uses a rotating and ~~transversely~~ traversely moving top plate as part of the mechanical device~~,~~; and
applying the mechanical pressure is applied to cause reflow of the ILD layer.

12. (Amended) The method as claimed in claim ~~7~~ 8 wherein:
applying the mechanical pressure uses a rotating and ~~transversely~~ traversely moving roller as part of the mechanical device~~,~~; and
applying the mechanical pressure is applied to cause reflow of the ILD layer.

13. (Amended) The method as claimed in claim ~~7~~ 8 wherein:
holding the low dielectric constant ILD material at a temperature below the hard back temperature in the oven holds the temperature between 100°C and 400°C; and
exhausting volatile gases from the ILD material from the oven.

14. (Amended) The method as claimed in claim ~~7~~ 8 wherein:
applying mechanical pressure uses a mechanical device having a consumable surface in contact with the semiconductor wafer.